



# **Structural Components of Wildlife Habitat**

# ***Structural Components of Wildlife Habitat: Snags, Downed Logs, and Hardwoods***

## **Introduction**

In connection with Sustained Yield Plan (SYP) requirements regarding wildlife habitat and as part of the Habitat Conservation Plan (HCP) for snag-related species on PALCO's ownership, PALCO will implement the measures identified herein to retain important structural elements of forest habitats. These measures complement other habitat conservation provisions of the SYP and HCP, including but not limited to those regarding riparian management zones (RMZs) and marbled murrelet conservation areas (MMCAs).

## **Background**

On the managed forest landscape it is important to consider the structural needs of wildlife through time and harvest rotations. Important structural elements for wildlife are snags, downed logs, live wildlife trees, and hardwoods. Snags have been defined as any dead or partially dead tree at least 4" d.b.h. and at least 6' tall (Thomas et al. 1979). Partially dead trees, for example redwood trees with dead tops caused by lightning, wind, age, rodents, or other factors, can provide habitat for species dependent upon snags. Live or "green" wildlife tree is a term used to describe a living tree that could be retained as a snag recruitment tree and may also have other wildlife habitat attributes such as green culls. Retention of structural habitat elements can sustain biological diversity, including key species, and maintain soil productivity (Swanson and Franklin 1992). Residual stand components and their replacements may account for similar animal abundance between unmanaged and managed stands (Rosenberg and Anthony 1993). Management for these components is intertwined, as live trees (both conifer and hardwood) can eventually become snags and/or downed logs.

There is an abundance of existing literature supporting the importance of snags and downed logs to wildlife abundance and diversity (e.g. Thomas 1979, Neitro et al. 1985, Knutson and Naef 1995). Unfortunately, most of this information has not been generated through study of the redwood/Douglas-fir region. PALCO has limited information on snag quantity and quality on its lands because past inventories have focused on merchantability only. More recent information on snags for PALCO lands has been generated by plot measurements as part of the multi-species study. The bulk of available information is based on studies of the mixed conifer forests of Oregon and Washington. Limited information is available for the Douglas-fir/tanoak habitats of northern California (i.e. Jimerson 1989). However, the available information is somewhat applicable to the redwood, Douglas-fir, montane hardwood-conifer, and montane hardwood forests found on the PALCO ownership due to certain commonalities. These commonalities include the presence of Douglas-fir (*Pseudotsuga menziesii*) and tanoak (*Lithocarpus densiflorus*) tree species, primary cavity excavators such as pileated (*Dryocopus pileatus*) and hairy (*Picoides*

*villosus*) woodpeckers, and sciurids such as the northern flying squirrel (*Glaucomys sabrinus*) and the Douglas' squirrel (*Tamiasciurus douglasii*).

Research has shown that greater than 100 species of vertebrates utilize snags at some time during their life cycle (e.g. Thomas 1979, Neitro et al. 1985). Pileated woodpeckers depend on large snags for both roosting and nesting. The abandoned cavities resulting from their excavations are used by many other mammal and bird species, including American martens (*Martes americana*) and Vaux's swifts (*Chaetura vauxi*) (Bull and Holthausen 1993). At maximum populations, hairy woodpeckers may use a greater number of soft snags per acre (approximately 192 per 100 acres 15" d.b.h.) than any other primary excavator (Neitro et al. 1985). Bats use cavities in live or dead trees for communal day roosts or maternity roosts (Christy and West 1993). Pacific fishers (*Martes pennanti pacifica*) use living or dead trees for resting sites and dens (Ruggiero et al. 1994, Zielinski 1995).

The use of dying and dead trees, including downed logs, by vertebrates is distributed throughout various sizes and stages of deterioration (e.g., Cline et al. 1980). In their study of Pileated woodpeckers in northeastern Oregon, Bull and Holthausen (1993) found that the birds foraged 38% of the time on snags, and 38% of the time on downed logs. They found that the best predictor of Pileated woodpecker density was the presence of snags 20" d.b.h. and 18' tall. Living and dead trees used for fisher dens ranged from 12" to 35" d.b.h. (Ruggiero et al. 1994). Resting sites discovered by Buck (1983) had an average d.b.h. of 45". The mean estimated d.b.h. of live trees and snags used by fishers for resting sites in the Pilot Creek and Grouse Creek watersheds of Eastern Humboldt County was 36.33" (Zielinski et al. 1994). On the Gasquet Ranger District of Six Rivers National Forest snag densities in old-growth Douglas-fir stands had an estimated average of 2.72 medium and large snags per acre, 20" d.b.h. and 20' tall (Jimerson 1989). In an analysis of snag literature done by Richter (1993), the mean d.b.h. of snags reported to be used by wildlife ranged from 22" to 46".

Carey (1995) found that northern flying squirrels were approximately two times more abundant in old forests than in young, managed stands without old forest legacies (large live trees, large snags, and large downed logs). However, this research indicated that populations in young forests with legacies and a developed brushy understory may equal those in the old forest. Carey's data indicated that at least 2.8 large snags per acre, and well-distributed patches of dense shrubs were necessary for high densities of flying squirrels. The study areas of Bull and Holthausen (1993) had snag densities ranging from a low of 1.16/acre to a high of 4.16/acre. Snag densities in conifer-hardwood forests of Oregon and Washington ranged from .86/acre in grass-forb and shrub habitats to 4.79/acre in large saw timber and old-growth (Ohmann et al. 1994). Richter (1993) determined that the average recommendation for snag retention stated by snag researchers was approximately three large snags per acre.

Spies and Cline (1988) found that, in the coast range of Oregon, coarse woody debris (c.w.d.) in managed stands averaged 61% of that in old-growth stands. However, the mean cover of c.w.d. did not differ statistically between young and old stands because of high variances, particularly in old-growth. Data developed by Spies and Franklin (1991) suggests that 15% to 20% cover of c.w.d. on the forest floor, well distributed across the stand, would be adequate for most small mammals. Thomas (1979) recommended for wildlife habitat in general that approximately two logs per acre 12" to 17" diameter at the large end and 20' in length should be retained.

In the low elevation temperate forests of the PALCO ownership conifer regeneration is relatively rapid. Hardwoods, mainly tanoak and Pacific madrone (*Arbutus menziesii*), provide a persistent broadleaf component of both redwood and Douglas-fir dominated stands. Hardwood dominated stands have resulted in some areas due to partial or complete harvest of the original conifer dominated stands. Mature hardwoods provide habitat for cavity nesting species. Mast crops are important food sources for many bird and mammal species. Among the species which use acorns as a major food source are: wild turkey, quail, band-tailed pigeon, ground squirrels, dusky-footed woodrat, black bear, and deer. Klug (1997) found that hardwoods are an important component of fisher habitat in this region.

The species and density of the hardwood component of PALCO forests varies with factors such as location, aspect, and soils. Analysis of more than 5,000 vegetation inventory plots for PALCO timber types reveals the following regarding hardwoods:

- For California Wildlife Habitat Relationships (CWHR) redwood types sampled, the average percent basal area of hardwoods was approximately 4%;
- For Douglas-fir CWHR types sampled, the average percent basal area of hardwoods was approximately 7%; and
- For hardwood CWHR types sampled the average percent basal area of hardwoods was approximately 35%.

In general, percent basal area of hardwoods is higher in the younger, more open stands. This is indicative of the invasive nature of these hardwood species, which can quickly capture a site until such time as conifers begin to shade them out.

Observations of Douglas-fir stands partially harvested 30 to 50 years ago indicates that the hardwood component is indeed persistent, and can achieve relatively large sizes. Hardwood snags will be used to meet snag retention requirements where standards can be met. In regard to stocking, hardwoods will be used to meet stocking requirements within RMZs. They will also be used to meet stocking requirements in upslope areas, as specified by the RPF. For example, they will be incorporated into prescriptions to meet wildlife perspectives such as snag retention and recruitment, and other habitat retention areas.

Snag and downed log abundance generally increases with stand development. Small snags are provided early and in relatively high numbers during stand development due to suppression mortality (Neitro et al. 1985). As a Douglas-fir forest matures there is: 1) a decrease in snag recruitment and density; 2) an increase in average and maximum snag size; and 3) an increase in the variety of sizes, species, and stages of snags. Similar patterns are likely to occur in other unmanaged coniferous forest types (Neitro et al. 1985).

In early and mid-successional managed stands large remnant snags provide most of the existing nesting habitat for cavity excavators. Replacements for large remnant snags into the next rotation of managed stands are necessary to sustain biodiversity (Ohmann et al. 1994). Cline et al. (1980) recommended the maintenance of existing snags in mature forest, especially in riparian buffer strips; maintaining large (> 20" d.b.h.) snags in managed forests in different stages of deterioration; and the retention of some large defective trees for future snags. These

recommendations are similar to those of Ohmann et al. (1994), with the additional suggestion that snag and stand dynamics be considered over long time frames (at least one rotation). Due to fire and safety concerns random distribution may not be feasible, and so aggregations along streams and lower slopes is preferable. Additionally, retention of all existing dead or dying trees may not be feasible or prudent. For example, when black bears kill a large aggregation of young conifers in a concentrated area, or where fire kills a number of trees in a stand such that salvage is a prudent measure.

Based on a small sample of 139 vegetation plots done as part of the multi-species study on PALCO lands the following information is available:

Seral Stage	No. of Plots	Snags/Acre	Avg. D.B.H.	Max. D.B.H.	Avg.>24"
Young	28	0.65	6.06"	53.3"	0.20
Mid	39	2.26	11.69"	83.4"	0.56
Late	61	2.56	23.29"	140.0"	0.83
Hardwood	8	2.07	15.15"	40.0"	0.572

Although the variation associated with this sample is quite large, this information does provide some baseline conditions. The information generally corresponds to the impression that, through intensive management or other prescriptions, the number of available large snags has become a concern. In some cases, past directives from government agencies has required the removal of snags for fire and other safety reasons, just as woody material was once required to be removed from watercourses. Now that it is recognized that these habitat elements are necessary for wildlife, a long-range strategy to ensure that they exist on the landscape is needed.

## Measures

The measures that PALCO will implement focus on the needs of snag-related species, with special emphasis on five of the species covered by the HCP---Vaux's swift, purple martin (*Progne subis*), pileated woodpecker, Pacific fisher, and Humboldt marten (*Martes americana humboldtensis*). Specific measures are as follows.

### 1. Snags

- a. Regarding snags, the objective will be to recruit and maintain snags, conifer or hardwood, in the following size categories:

- 1.2/acre at least 30" d.b.h. and 30' tall
- 2.4/acre at least 20" d.b.h. and 16' tall
- 1.2/acre at least 15" d.b.h. and 12' tall

The majority of snags and leave trees will be concentrated along Class I and II streams. Additional snags and green cull trees will be retained, preferably in clumps, within harvest units along Class III watercourses to meet the above objective and to distribute/snags into upslope areas.

- b. When applying the snag retention/recruitment objective within timber harvest units,
  - 1) Larger snags may be substituted for smaller snags.
  - 2) All snags will be retained which do not pose a hazard to workers during harvest operations.
  - 3) Trees of appropriate sizes within the RMZs of Class I and II streams will be counted towards the objective.
  - 4) If the objective cannot be met in a harvest unit (i.e., THP) with existing snags, green replacement trees may be substituted on a 1:1 ratio in the nearest size categories. Green cull trees and whitewood conifer species will be targeted for retention before redwood.

## **2. Downed Logs**

Regarding downed logs, the objective will be to retain two downed logs per acre outside the Class I and II RMZs of any decay class, 15" diameter at the large end and 20' long. There will be no requirement to leave downed logs where they do not exist already.

## **3. Information Gathering and Monitoring**

Due to the current lack of information regarding quantity and quality of snags and downed logs, monitoring is a key component of this strategy. Monitoring will develop data on these habitat components for each hydrologic unit of the PALCO ownership.

- a. Information will be gathered by the RPF (or designee) concerning snags, downed wood, and leave trees and will be incorporated into proposed THPs.
- b. Monitoring of snags and downed logs will occur during reforestation inspections, timber stand improvement monitoring, or timber stand cruises. This monitoring program may be altered in the future, but if alternations are made they will conform to the standards set forth here, and those developed in consultation with USFWS and CDFG.

## **4. Training Program**

A training program for Registered Professional Foresters, wildlife and fisheries biologists, Licensed Timber Operators, and all other technicians responsible for implementing this strategy will be designed and implemented. PALCO will work with USFWS and CDFG in developing the training program.

## **5. Evaluation**

- a. At the end of the first year of plan implementation, PALCO will meet with the USFWS and CDFG to review the data collection and monitoring procedures and determine if they are effective in producing the information required to implement the snag and downed log measures. Changes in procedures, if necessary, will be developed by PALCO in cooperation with USFWS and CDFG.

- b. After five years of plan implementation, the effectiveness of the recruitment measures will be evaluated against the objectives based on monitoring results and following an intensive inventory and measuring of stand components. If the snag objectives are not being met through the recruitment procedures identified above, PALCO will develop and implement aggressive measures. Such measures may include additional marking and retention of recruitment trees or girdling and inoculation of trees with pathogens to accelerate mortality and decay.
- c. Following the five-year assessment, the effectiveness of the measures and attainment of the objectives will be evaluated at intervals of five to ten years.

## References

- Buck, S., C. Mullis, and A. Mossman. 1983. Final Report: Corral Bottom-Hayfork Bally Fisher Study. (Unpublished Report): USDA in cooperation with Humboldt State University, Arcata, CA.
- Bull, E.L., and R.S. Holthausen. 1993. Habitat use and management of Pileated woodpeckers in Northeastern Oregon. *J. Wildl. Manage.* 57(2) 335-345.
- Carey, A.B. 1995. Sciurids in Pacific Northwest managed and old-growth forests. *Ecological Applications*, 5(3), 1995, pp.648-661.
- Carey, A.B. and M.L. Johnson. 1995. Small mammals in managed, naturally young, and old-growth forests. *Ecological Applications*, 5(2), 1995, pp.336-352.
- Christy, R.E., and S.D. West. 1993. Biology of bats in Douglas-fir Forests. Gen. Tech. Rep. PNW-GTR-308.
- Cline, S.P., A.B. Berg, and H.M. Wight. 1980. Snag characteristics and dynamics in Douglas-fir forests, Western Oregon. *J. Wildl. Manage.* 44(4): 1980.
- Jimerson, T. 1989. Snag densities in old-growth stands on the Gasquet Ranger District, Six Rivers National Forest, CA. USDA, Research Paper PSW-196. 12 pp.
- Klug, R.R. Jr. 1997. Occurrence of Pacific Fisher (*Martes pennanti pacifica*) in the Redwood Zone of Northern California and the Habitat Attributes Associated with their Detections. MS Thesis, Humboldt State University. 50 pp.
- Knutson, K.L. and V. Naef. 1995. SNAGS: Management Recommendations for Washington's Priority Habitats. Draft Document. Washington Department of Fish and Wildlife. 600 Capitol Way, N. Olympia, WA. 98501-1091. 137 pp.
- Maser, C. And Z. Maser. 1988. Interactions among squirrels, mycorrhizal fungi, and coniferous forests in Oregon. *Great Basin Naturalist*. 48: 358-369.
- MacMillan, P., J. Means, G.M.Hawk, K. Cromack, Jr., and R. Fogel. 1977. Log decomposition in an old-growth Douglas-fir forest. Northwest Science Assoc. Program and Abstract of the papers scheduled for presentation at the 50th annual meeting. P. 13.

- Means, J.E., MacMillan, P.C., and Cromack, K. Jr. 1992. Biomass and nutrient content of Douglas-fir logs and other detrital pools in an old-growth forest, Oregon, USA. *Can. J. For. Res.* 22: 1536-1546.
- Neitro, W.A., et al. 1985. Snags (wildlife trees) *in* Management of wildlife and fish habitats in forests of Western Oregon and Washington. E.R. Brown, Tech.ed. USDA Forest Service Pacific Northwest Region.
- Ohmann, J.L., W.C. McComb, and A.A. Zumrawi. 1994. Snag abundance for primary cavity-nesting birds on non-federal forest lands in Oregon and Washington. *Wildl. Soc. Bull.* 22: 607-620.
- Richter, D.J. 1993. Snag resource evaluation. California Department of Fish and Game, Environmental Services Division, Admin. Rep. 93-1. 28 pp.
- Rosenberg, D.K., and R.G. Anthony. 1993. Differences in Townsends's Chipmunk populations between second and old-growth forests in Western Oregon. *J. Wildl. Manage.* 57: 365-373.
- Ruggiero, L.F., K.B. Aubry, A.B. Carey, and M.H. Huff. 1991. Wildlife and vegetation of unmanaged Douglas-fir forests. US Forest Service Gen. Tech. Rep. PNW-285.
- Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech. Eds. 1994. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the Western United States. Gen. Tech. Rep. RM-254. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 184 pp.
- Spies, T.A., and S.P. Cline. 1988. Coarse woody debris in forests and plantations of Coastal Oregon. Pp. 5-24 *in* C. Maser, R.F. Tarrant, J.M. Trappe, and J.F. Franklin, tech. Eds. From the forest to the sea: a story of fallen trees. US Forest Service Gen. Tech. Rep. PNW-GTR-229.
- Spies, T.A., and J.F. Franklin. 1991. The structure of natural young, mature, and old-growth forests in Oregon and Washington. Pages 91-110 *in* L.F. Ruggiero, K.B. Aubry, A.B. Carey, and M.H. Huff. 1991. Wildlife and vegetation of unmanaged Douglas-fir forests. US Forest Service Gen. Tech. Rep. PNW-285.
- Swanson, F.J. and J.F. Franklin. 1992. New forestry principles from ecosystem analysis of Pacific Northwest forests. *Ecological Applications*, 2(3), 1992, pp. 262-274.
- Thomas, J.W., et al. 1979. Wildlife habitats in managed forests; the Blue Mountains of Oregon and Washington. Ag. Handbook No. 553. USDA Forest Service.
- Zielinski, W., G. Schmidt, and K. Schmidt. 1994. Six Rivers Nat'l. Forest Fisher study progress report, 10 June 1993 - 27 October 1994. USDA Forest Service Region 5, 20 pp.
- Zielinski, W.J. 1995. Six Rivers National Forest Fisher Study Progress Report II. USDA Forest Service Pacific Southwest Experiment Station, Arcata, CA. 29 pp.



